Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 197 (2015) 2369 – 2376

Procedia
Social and Behavioral Sciences

7th World Conference on Educational Sciences, (WCES-2015), 05-07 February 2015, Novotel Athens Convention Center, Athens, Greece

# The Development Of The Logical Operators In Students With Intellectual Disability

Viorel Agheana[a]*, Ruxandra Folostina [a]

[a]*University of Bucharest, Faculty of Psychology and Educational Sciences, Panduri 90, Bucharest 50663, Romania*

**Abstract**

This particular research aims to develop micro-operations of thinking, called logical operators to students with intellectual disabilities through a program specifically designed to drive them in special education. Training program consisted of logical operators in learning activities at the acting, iconic and verbal level, based on formative side extension curriculum and finding the most appropriate training problems and exercises a certain micro-operations of thinking. Cognitive development programs have tried to expand the "zone of proximal development" of the child, in other words, to overcome the current level of development, trying to reach his full potential cognitively.



Peer-review under responsibility of Academic World Education and Research Center.

*Keywords:*intellectual disability, cognitive development, thinking, logical operators, proximal development zone

## 1. Introduction

According to DSM-V, the definition of Intellectual Disability (Intellectual Developmental Disorder) is: a disorder with onset during the developmental period that includes both intellectual and adaptive functioning deficits in conceptual, social, and practical domains that result in failure to meet developmental and sociocultural standards for personal independence and social responsibility. Without ongoing support, the adaptive deficits limit functioning in one or more activities of daily life, such as, communication, social participation, and independent living, and across multiple environments, such as home, school work and recreation.

* Viorel Agheana Tel.: 004-0727-502-005
*E-mail address:*agheana_viorel@yahoo.com



Peer-review under responsibility of Academic World Education and Research Center.
doi:10.1016/j.sbspro.2015.07.289

Piaget substantiated theoretically and experimentally operative character of thinking. Following the birth of intelligence in children and the development from sensory-motor stage to logic, abstract intelligence stage, he demonstrated that the essential feature of logical thinking is to be operative, meaning that prolong the action, internalizing it. Mental operations can be understood as internalized forms of concrete operations. The operation is active element of thinking, which provides essential progress of intelligence. Any operation consists of partial operations, continuous coordinated with each other and together with the other operations form coherent and solid systems. Logical operator is "functional model or scheme which performs a specific operation" (Popescu-Neveanu, p. 498) and refers to: similarities, simple sorting, sorting, grouping, association, classification and pre classification, series - ordering, compare and global assessment, corresponding, etc.

Logical operator is "functional model or scheme which performs a specific operation" (Popescu-Neveanu, p. 498) and refers to: similarities, simple sorting, sorting, grouping, association, classification and pre classifications, series-ordering, compare and global assessment, corresponding, etc.

According to Piaget theory, intellectual disability can be defined by unfinished operative building. During ontogenesis, the child with intellectual disabilities is only capable to execute concrete operations, as opposed to normal one, which, at the age of 14-15 years old, already has a formal operative structure. The development of the person with profound mental disability does not exceed the maximum sensor-motor intelligence, in other words, that level at which the child is normally developed during the first two to three years of life. I.S. Rubinstein (1979) shows one of the most common manifestation of abstraction and generalization difficulties which consists in excessive concrete in thinking, in pronounced inability of the intellectually disabled student to emerge directly from the concrete, from the situation experienced in the moment and inability to make generalizations and to verbalize (acknowledge) their own experience. Studies have shown that people with intellectual disabilities have difficulties in transferring in new situations knowledge and skills already acquired (Alberto & Troutman, 2009), therefore the transfer of knowledge acquired during the teaching process to real life situations in students with intellectual disabilities should be the main issue when the educational activities are projected.

Paunescu and Musu (1995) described how defective the child with intellectual disabilities operates concepts "the assessment of the fact that the child with intellectual disabilities has acquired a certain notion is invalidated in the conditions under which it must operate with it to solve a practical problem. In reality, we are in a false progress situation: notions are mechanically recorded and simply "reciting" without being capable of real operating "(p. 227). Kirk, Gallagher and Anastasiov (2000) show that students with intellectual disabilities hardly succeed to operate with separate ideas and concepts and they have difficulties to recognize common themes and relationship between them. Students with intellectual disabilities have a big problem with generalizing information, which are unable to use for a potential situation to another (Hunt & Marshall, 2002).

It is generally accepted that, depending on the form and the level of intellectual disability, children with intellectual disabilities go through the same sequence of stages of development as normal children, from sensor-motor to concrete operations stage, but the time necessary for this evolution is longer than in normal children (Dockrell & McShane, 1992). Analyzing the causes that could underpin the fact that children with intellectual disabilities never exceed the concrete thinking stage Sousa (2001) suggests that this happens because the organic factors, such as brain damage, can alter neural architecture, and also the cognitive one, making the information more difficult to decode. The child with intellectual disabilities forms his concrete operative structure, even if that's happening quite late, but without the possibility of exceeding it further, so that we can talk about limiting rather than ending - in the operator sense – to the development of intelligence.

## 2. Method

### *2.1. Purpose of the study*

Our research aims to develop logical operators in students with intellectual disabilities through a program specifically designed to train them in special education at the acting, iconic and verbal level. From theoretical point of view our research had as milestones the following relevant theories on the development of thinking, his operative character and the conduct of learning in children with intellectual disabilities:

a. Psychogenetic theory (J. Piaget) - intellectual development is seen as a succession of stages of the thinking evolution and operative character of thinking;

b. Social Constructivism and the zone of proximal development (Vagotski, 1971) – the child development as a process of assimilation of cultural experience and zone of proximal development as the distance between the actual and potential level of development;

c. Structural and genetic-cognitive theory (Bruner JS) – the processing of the knowledge and learning at the acting, iconic and verbal level;

d. Theory of Structural Cognitive Modifiability (Feuerstein) – the concept of "structural cognitive modifiability": the development is determined by genetic factors and / or neurophysiologic, environment and mediated cognitive education based on a program specially designed to increase development (mediated learning experience).

### *2.2. Participants*

The experimental group and the control group included 47 students with intellectual disabilities each, aged 4 to 17 years, classified as intellectual HAVING disability (IQ values ranged from 42 to 68) Stanford-Binet According to measurement. Were children selected from woven to special education school for children with intellectual disability from Bucharest, Romania and the groups were made by IQ criteria so that groups have a similar profile.

### *2.3. Training procedure*

In the first stage of the research we evaluated children with intellectual disabilities in the sample group through a set of operatory tests developed by the experimenter in which has been considered in terms of design, psychogenic operatory tests - different difficulty levels corresponding to certain stages as Piaget psychogenic theory. Unlike conventional tests, the purpose of these tests is not to classify some children over others but to rate the level achieved. Through its items, these tests highlight the operations the child is already capable and the ones that supposedly can solve, but under certain conditions, with particular support to ensure entering the zone of proximal development.

After the initial evaluation we complete an intensive cognitive training program with the students from the experimental group. This program was completed in groups of 2-3 children with similar age and intellectual development characteristics during the 2013-2014 school year. The cognitive training program consisted in problems and exercises for training logic operators using a variety of tools activities in the environment, concrete objects, figures, pictures, verbal processes and computer through appropriate software.

Cognitive development program was based on the operatory tests, with the foundation of the Feurstein Theory of Structural Cognitive Modifiability. The program consisted of training the logical operators in learning activities at the acting, iconic and verbal level, using the three different ways that ensure the efficiency of training in the conception of Jerome Bruner. Through the cognitive development program we tried to enlarge "zone of proximal development" (Vagotski,1971) of the child, i.e., to overcome the current level of development represented by what the child is able to do alone, trying to reach his maximum cognitive potential, through scientifically based support oriented to solving learning tasks which marks the transition to zone of proximal development.

We also considered mediating sense of responsibility for the student with intellectual disabilities to live comforting feeling of competence. The feeling of competence was assured of a double intervention:

- Structured tasks in a way that ensures their successful achievement;
- Interpretation of the smallest sign of success as an increase of mediate proficiency.

To the children with intellectual disabilities in the experimental group were constantly drawn attentions to the elements of personal conduct, which have favored finding the right solution to strengthen confidence in their own competence.

The starting point was the development of sensory knowledge base through direct action with objects, following the trail from perceptive to cognitive development. Solving problems which establish specific questions, comparing an item with elements of the same class and of different kinds, for example, the child learns how to operate with concepts, useful quality both in school activities as in concrete situations of life. Each student involved in the

program got through at least one activity of cognitive training weekly. The child must solve problems and exercises using some logical operators, identifying a corresponding logical operator, and on this basis they are required to find a system of organizing the relations between the parties presented by the problem. Internalizing the actions of children at acting and then iconic and verbal level can lead to organized mental structure in terms of its functionality available to the student with intellectual disabilities so that to represent, to establish mentally, through a series of operations, some reports and find a system of organizing these relationships. In order to learn concepts, it have been used three concrete physical objects differently representing the same concept, three representations in the form of imitation of the same objects and three different sets of images representing respective object. For example, in order to learn the concept of fruit were used three different fruits: apple, banana, cherry, then plastic representations of these fruits and after that image of fruits were presented to the child.

Meetings were held as follows:

- Preparing materials for the meeting before bringing the child into the room;
- Meeting began by capturing the attention of the participant (e.g., "Are you ready? Today we'll learn what are...);
- Explaining the rules (e.g. "I'll show you a thing. Even if you know what it is, you'll only respond if I ask you").

The meeting begins by presenting objects one by one. The child is encouraged to touch and manipulate each object, which is then placed on a table. Correct answers are reinforced with verbal praise; if the answer is incorrect or the child gives no response, auxiliary questions are asked until the child responds correctly.

Mental operations complex which the subject is getting through run its course in the following manner: it suggests to the child, based on objects, images or verbal instructions, a way of organizing with some degree of connection, under the operational field. The subject must represent to himself and establish mentally through a series of operations some relationships and find a system of organizing these relationships. The organization system of the relations between the presented parties and the entire structure represents the organizing of mental structure and its functionality.

For example, we present a fruit to the child: the apple. Depending on the operational level at which we want to work, the child is given other objects, images or is presented verbally various other elements of the reality, which must be placed in this category, for instance, a banana. The image of apple and the image of banana do not have elements which look alike. So, the elements that lead to the overlap identification are missing. The child must reconstruct the whole process starting from the reception of visual stimuli, so from the sensations and perceptions, and, through a series of composition analyzes of the usability in most cases, followed by generalization- synthesis, to reach a ranking formula. So, the subject must have a notion or if is not formed, to build one that will activate the thinking operations system leading to overcoming the current state of thinking development. In our case, for the subject to sort banana in apple category must exist or be formed the notion of fruit. Categorical confusion denotes the absence of integrators at the concepts level and their ability to operate at the thinking operations level. After completing the cognitive development program students in the control group and the experimental group were tested again using similar tests with logical operators.

## 3. Results

To highlight the progress differences between the experimental and control group we used statistical analysis using SPSS software and Paired Samples T Test. The aim of our analysis was to statistically argue if the performance of students with intellectual disabilities from the experimental group were significantly higher than those of the students from the control group in terms of completing a cognitive development program. Null hypothesis is that between the two assessments will not have significant differences, so that the performance of students in the experimental group will not increase significantly.

For the control group the results were as follows:

Table 1. T-Testresults for the control group

| Paired Samples Statistics | | | | | |
|---|---|---|---|---|---|
| | | Mean | N | Std. Deviation | Std. Error Mean |
| Pair 1 | initial | 27,87 | 47 | 13,442 | 1,961 |
| | final | 28,85 | 47 | 13,455 | 1,963 |

| Paired Samples Correlations | | | |
|---|---|---|---|
| | | N | Correlation | Sig. |
| Pair 1 | initial & final | 47 | ,991 | ,000 |

| Paired Samples Test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | initial final | -,979 | 1,824 | ,266 | -1,514 | -,443 | -3,679 | 46 | ,001 |

Statistical analysis indicated that the average of the initial and final evaluation for the control group is 0.979. The fact that is a negative value shows the average score obtained in the final assessment is higher than that obtained in the initial evaluation.

Analyzing the differences in the average of the results for the tests with logical operators for the experimental group the results were as follows:

Table 2. T-Test results for the experimental group

| Paired Samples Statistics | | | | | |
|---|---|---|---|---|---|
| | | Mean | N | Std. Deviation | Std. Error Mean |
| Pair 1 | initial | 28,32 | 47 | 14,121 | 2,060 |
| | final | 34,04 | 47 | 13,676 | 1,995 |

| Paired Samples Correlations | | | | |
|---|---|---|---|---|
| | | N | Correlation | Sig. |
| Pair 1 | initial & final | 47 | ,953 | ,000 |

| Paired Samples Test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | initial final | -5,723 | 4,302 | ,628 | -6,987 | -4,460 | -9,120 | 46 | ,000 |

We found that the average of the initial and final assessment for the experimental group is 5,723, so there is a significant difference between the two evaluations and t test for paired samples $t = 9,120$ $p < 0.01$ statistically argue this hypothesis. Also, the correlation coefficient of 0,953 between the initial and final evaluation for the experimental group shows that the cognitive development program equally influenced students so that their results follows an ascending curve, regardless of the level of intellectual development of each. In conclusion, we believe that our hypothesis was confirmed. Statistical analysis allowed us to identify significant differences between performances in children with intellectual disabilities from the experimental group and control group students. The average difference between the initial and final assessment of 0,979 for the control group is lower than the average difference between the initial and final assessment for the experimental group which is 5,723, so we can say that in terms of systematically cognitive training applied to the mental operations level it will produce a significant change in terms of student with intellectual disabilities performance in solving problems.

## 4. Discussions

Difficulties in the process of ordering, classification, ranking is significant characteristic of students with intellectual disabilities, but also can cause new skills of cognitive learning through a structured approach, changing the child's information system and practicing systematic micro-operations of thinking. In children with intellectual disabilities knowledge has fragile and fragmentary character, especially when they involve a process of generalization and systematization of thinking. During the present research students with intellectual disabilities tended to form large groups of objects using unusual classification criteria which became important for them. Attention to some seemingly insignificant details and the use of accidental or arbitrary selection criteria makes the time required to find the classification principles to be longer and they have more difficulty when should switch from one classification criterion to another. When is operating on the basis of sensory elements child with intellectual disabilities uses especially perceptive criteria "apple is in the tree" and type of concrete similarities "ball is round like an apple."

In most cases, the way how children with intellectual disabilities determine the similarity between things in their environment, i.e. when can be said about things that are "similar" is object of subjective and arbitrary rules. For example, apple, milk, bread are similar because they are all edible, but for children with intellectual disabilities milk and bread are similar because they ate the lunch break, apple and bread are similar because it seems that they both have the same color or they have cover etc. These rules used by children with intellectual disabilities are difficult to anticipate but all operate based on peripheral similarities with appearances.

Cognitive Development Program revealed another typical behavior of child with intellectual disabilities: he retains only one element of assignment (color or position of parts of an item) and forget or do not perceive the assignment all together and this is happening because the student with intellectual disabilities can't get through under conscious control two to three criteria simultaneously. If the assignment exceeds his possibilities, child with intellectual disabilities makes choices which have only one element of the right solution - indicates a certain position of the item, which proved correct in the previous exercise - or makes random choices. These are also signs of fatigue and that's the reason why it is good to appreciate the right time when the exercise should be stopped because the child answers will remain incoherent and inconsistent. It is useful to give the child to solve various tasks in terms of form; with breaks in which the child should rebuild his forces. In most cases we found that in students with intellectual disabilities the assimilated concepts are not authentic, operative, there are rather a verbal construct, terms more or less devoid of content. The child with intellectual disabilities cannot organize knowledge based only on disparate concepts. He needs to use logic that only the active use of language can give him in the context of maturation through learning. In this way the concept operates selectively, and the language becomes a superior system of integration and an operator system. These properties of the concept exist only by exercising language. Although using concrete objects or their representations can lead to progress on the development of logical operators only verbal tests can prove that concepts have been assimilated correct, and language provides greater selection strength, differentiation and concepts efficiency.

When the child with intellectual disabilities is involved in a learning activity, expressed or implied objects name or their representations is fundamental in learning words and concepts. The results are in concordance with previous research (Paivio, 1971) which showed that if the image evokes a word, the concrete word evokes (even if less accurate and less frequently) an image (dual coding theory).

Correct answers of children with intellectual disabilities in verbal tests are to a low level, some of them gave by accident. They cannot find any reference for organization or conceptual structure, although some of these subjects have all words in the current vocabulary, including some of the top integrators. In children with intellectual disabilities words were not transformed into concepts, and remain imprecise forms, uncertain, which only contact with the immediate reality can mobilize and activate. Child with intellectual disabilities usually uses „verbal labels" and not concepts, notions and faced with a problematic situation he did not need to clarify and resolve. This fact is of major importance when we want to lead the child with intellectual disabilities in the zone of proximal development.

The most common types of conceptual definitions to the student with intellectual disabilities are tautological: "apple is an apple" and the utility ones "the apple is something to eat". There are also attempts of descriptive analytical definitions based on nonessential indicators, unrepresentative "the apple is red", "the apple is round" etc.

When sorting a banana and apple together and not with a dog means already operating with a logical categorical criterion. These categories are themselves parameters of concepts such as class, genus, species; integrative concepts.

Application of tests with logical operators has led us to the conclusion that even in the absence of language is possible for children with intellectual disabilities to operate with some higher integrative notions (class, gender). It is also possible for them to come to acquire some operatory forms in concept level.

Performance of the children with intellectual disabilities is also affected by the difficulties of attention concentration and by lack of perseverance in carrying out tasks. During tests with logical operators often appears the lack of reaction but also correct reactions parasitized by errors and in verbal tests the response time increases, probably due to installed fatigue, issue applicable to the entire group of students with intellectual disabilities investigated.

In the case of logical operators exercises some defective cognitive stereotypes should be broken and reproduced into a new structure, this time the right one.

## 5. Conclusions

Difficulties in the process of ordering, classification, ranking is significant characteristic for children with intellectual disabilities; but in the same time can lead to learning new cognitive skills through a structured approach, changing information system of the child and systematically practicing logical operators. Once formed, the operations provide great mobility and plasticity to the thinking process. For example, through the effects of similarity-difference operations – so, through the comparison made between objects - the child's mind with intellectual disabilities who participated to the cognitive development program succeeds, even if partially, to put them in relationships and correspondences, thus constituting substructures of the future operations of thinking. Exterior universe is ordered in partial and general sets of knowledge, together with the development of psychological structures corresponding to these operations. Student with intellectual disabilities should be trained permanently in operation with the learning material (concrete, iconic and verbal), acting in the zone of proximal development and being exposed systematically to educational influences. The existence of multiple intuitive elements on the same theme, but different in representation helps students with intellectual disabilities in forming concepts. Also, the existence of several intuitive representations helps students through comparison-opposition operations, to achieve a clearer understanding of the concept. Are useful the groups that help the child to grasp, and then set the recurrence relationship, especially complementary one of operations of thinking. Through numerous exercises of this kind an association's luggage is created which then helps correct use of micro operations of thinking in any context. All these knowledge and skills acquired by the child with intellectual disabilities are significant in terms of adaptive only to the extent that enable them to operate whenever necessary, from here resulting special importance of the continuous development of new plans, programs and teaching methods to improve the education process. We believe that in students with intellectual disabilities logical operators become functional when they succeed to apply them in everyday life and in concrete situations of life.

## References

Agheana, V.,Cretu, V., (2008). Procesarea continutului lectiei la nivel actional, iconic si verbal pentru dezvoltarea gandirii elevului cu handicap mintali, Bucuresti, Revista de Psihopedagogie, nr. 1.

Alberto, P. A., & Troutman, A. C. (2009). Applied behavior analysis for teachers (8th ed.). Upper Saddle River, NJ: Merrill-Prentice-Hall.

Alberto, P. A., & Troutman, A. C. (2009). Applied behavior analysis for teachers (8th ed.), Upper Saddle River, Merrill-Prentice-Hall.

Bruner, J., (1974). *Toward a Theory of InstructioHarvard University Press.*

Bruner, Jerome S. 1966. Toward a Theory of Instruction. Cambridge MA: Harvard University Press

Debra L. C., (2011). Implementing a Problem-Solving Intervention With Students With Mild to Moderate Disabilities, Intervention in School and Clinic, vol. 46, nr. 5.

Dockrell, J., McShane, J. (1992). Children's Learning Difficulties: A Cognitive Approach. Oxford, Blackwell.

Feuerstein, R., (1991). Mediated learning experience, London, Freund Publishing House.

Hunt, N., & Marshall, K.J. (2002). Exceptional children and youth: An introduction to special education (3rd ed.). Boston, MA, Houghton-Mifflin.

Inhelder, B., (1968). Le diagnostique du raisonnement chez les debiles mentaux, Neuchatel et Paris, Delachaux & Niestle.

Kirk, S., Gallagher, J., & Anastasiow, N. (2000). Educating exceptional children, (9th Ed.). Boston, MA, Houghton Mifflin.

Mialaret Gaston, (1999). Psychologie de l 'education, Paris, Presses Universitaires de France.

Paunescu, C., Musu, I. (1997). Psihopedagogia speciala integrata. Handicapul mintal. Handicapul intelectual, Bucuresti, Editura Medicala.
Piaget, J., & Inhelder, B. (1962). The Psychology of the Child. New York: Basic Books.
Piaget, J., (2001). The Psychology of Intelligence, London: Routledge.
Popescu-Neveanu, P., (1978). Dictionar de psihologie, Bucuresti, Editura Albatros.
Sousa, D. (2001). How the special needs brain learns. Thousand Oaks, CA, Corwin Press.
Vagotski LS., (1971). Opere psihologice alese, vol. I-II, Bucuresti, E.D.P.
Verza E., Verza F.coord. (2011). Tratat de Psihopedagogie speciala, Editura Universitatii din Bucuresti.